USDA United States Department of Agriculture

Conservation Effects Assessment Project (CEAP)

Conservation Insight

Small, diversified farms in New England provide conservation opportunities for shrubland birds

Key Takeaways

- Small, diversified agricultural operations provide similar bird conservation value as other habitats recognized as important contributors to shrubland bird conservation in New England.
- Fifty-two percent of birds encountered on small, diversified farms in New England were shrubland species.
- Certain shrubland species were positively associated with open-habitat characteristics such as herbaceous vegetation and cover crops on farms, while others preferred greater coverage of tall, dense, shrub and woodland habitat as well as smaller field sizes.
- Most bird species considered crop pests were associated with bare ground, herbaceous rowcrops and larger field sizes.
- Farms complement other shrubland habitat types by supporting shrubland species that prefer open-habitat characteristics.
- Farmers can promote bird conservation on their farms, while also reducing numbers of pest bird species, by reducing field sizes, providing tall, dense vegetation in non-production areas and increasing cover of hedgerows, shrub, and woodland habitats.

Background

In New England, agriculture has been one of the most important mechanisms driving changes in avian populations for centuries. European settlers cleared much of the original forest cover, such that by the mid-1800s, pasture, hay, and cropland accounted for nearly 75% of the land use in the region (Litvaitis, 1993). Thus, agricultural land use created opportunities for species that specialize in early-successional and shrubland habitats. However as human populations continued to expand and a primarily agrarian society was replaced by an increasingly urban, industrialized one, much of this early-successional habitat was lost to development or succession to second-growth forest. Today, agriculture accounts for only 5% of New England landcover; however in recent decades, farming in the region appears to be making a comeback, especially on small-scale diversified operations.

Shrubland bird populations across North America have declined by 16.5% since the mid-1960s and over half of those species that regularly breed in the northeast have shown either short-term or long-term population declines (Schlossberg and King, 2007; Stanton et al., 2018). As these declines have largely been attributed to loss or fragmentation of breeding and foraging habitat, conservation of shrubland species has become a high priority for natural resource managers. Government agencies and non-governmental conservation organizations have made considerable efforts to create and manage shrubland habitats to stem declines of the many

Photo credit: Isabel Brofsky

Willow flycatchers were observed in higher abundance on small, diversified farms than in other New England shrubland habitats.

More than half of the shrubland birds that regularly breed in the Northeast have experienced population declines.

In this study, investigators sampled birds and bird habitats on small, diversified farms across the Pioneer Valley of Massachusetts to assess their potential to support priority shrubland birds.

Natural Resources Conservation Service

species that rely on them (Schlossberg and King 2007, 2015).

Small, diversified farms in New England use a variety of production practices that foster habitat heterogeneity. These include the use of crop rotation and cover cropping, and the retention of natural habitats such as hedgerows, buffer strips, riparian corridors, meadows, shrublands, and woodlands adjacent to crop production areas. Small-scale, diversified farming not only supports biodiversity, it can also improve ecosystem services for farmers such as pest control and pollination, and on a broader-scale support efforts to bolster regional food security, self-sufficiency, and sustainability. Agricultural census data show significant increases in the percentage of New England organic farms practicing Integrated Pest Management (IPM) and releasing beneficial organisms (such as pollinators and pest predators and parasites) between 2008 and 2014 (USDA 2017). By 2014, nearly 45% of all New England organic farms maintained vegetated buffer strips, and close to 20% maintained habitat for beneficial insects and vertebrates.

As working lands that inherently use a variety of environmentally friendly practices, small, diversified farms can contribute to shrubland bird conservation by providing habitats that complement more deliberate wildlife management efforts. Incorporating these working lands into shrubland bird conservation work can help accommodate the broad range of habitats preferred by shrubland birds (Kremen and Merenlender, 2018; Schlossberg and King, 2007 and 2015). Establishing a better understanding of how these birds utilize small, diversified farms in this region will help inform how managers and farmers can optimize conservation opportunities within these habitats.

Blue-winged warblers are one of the priority shrubland bird species that use small scale diversified farms in the Northeast. Photo credit: Dave King.

Assessment Approach

Through a Conservation Effects Assessment Project (CEAP) partnership between NRCS and the University of Massachusetts, an assessment was conducted to evaluate the conservation opportunities for shrubland birds and other priority species on small, diversified farms in New England. Specific objectives were to: (1) characterize the breeding season bird communities of small, diversified farms, (2) quantify bird-habitat associations at the microhabitat-, patch-, and landscape-scale, and (3) compare bird abundance, community composition, and conservation value of small, diversified farms to other shrubland habitat types in New England.

Assessment of bird-habitat associations

Investigators surveyed breeding birds and habitat characteristics across 22 small, diversified farms in the Pioneer Valley of Massachusetts. Twenty of these farms were smaller than 50 acres, produced two or more farm products, and were either certified organic or were producing according to organic standards and therefore represented small, diversified farms typical of the region. Standardized point count surveys of breeding birds were conducted on these farms from May through July of 2017 and 2018. Surveys consisted of a trained observer counting all birds detected during a 10-minute sampling period within a 50-m radius of sampling points. Within each of the 50-meter radius point count plots, distinctive habitat types were delineated and classified from aerial imagery into land cover categories. At 5 random points within each habitat type inside the plot, vegetation species composition, height and density were recorded.

Ten microhabitat variables (vegetation height, vegetation density, percent cover of bare ground, cover crop, herbaceous rowcrop, herbaceous/grassland, hedgerow, woody rowcrop, woodland, and shrub) were examined. A principal components analysis (PCA) was conducted to reduce the dimensionality of the dataset from 10 variables to two axes which explained 44% of the total variance. The first principal component axis reflected a gradient from bare ground to tall, dense and woody vegetation. The second principal component described a gradient from agricultural production habitats such as herbaceous rowcrop to non-production cover types such as herbaceous/grassland and hedgerow.

In this analysis, the number of birds estimated to be present at a given point is a function of the number of birds counted and the probability of detecting each bird. Counts were adjusted to correct for detection probability using three variables: date, date squared, and time of day (Royle, 2004). Included in the analysis were breeding species present on at least 10% of the plots, with at least 30 total observations (Schlossberg and King, 2007), and were observed at least 20 total times exhibiting breeding or foraging behaviors. Seven habitat variables were examined representing three spatial scales: 1) patch scale—principal components one and two, 2) field scale—field size, and 3) landscape scale—percent cover of agriculture, development, forest, and wetland within a 200-m radius of the field. Multivariate analyses were conducted to explore the relationships between bird species and various microhabitat variables.

Comparison of bird communities across shrubland habitats

In addition to the farm data, bird survey data were compiled from studies of other shrubland habitats shown in Table 1.

Investigators used regular generalized linear models (GLMs) with a log link

Table 1. Survey data from previous studies of bird use of shrubland habitats in New England included for comparison to small, diversified farms. All bird data were collected using the same standardized point count protocol as used at farm sites.

Habitat type	Number of sites	Reference
Permanent wildlife openings maintained with mowing or burning	7	King et al., 2009b
Clearcuts created by silviculture where all tree canopy was removed	5	King et al., 2009b
Powerline rights-of-way maintained by targeted mechanical and herbicide treatments	15	King et al., 2009a
Beaver meadows consisting variously of marshy and shrubby conditions	37	Chandler et al., 2009
Small forest openings created by silviculture treatments	90	Roberts and King, 2017

and Tukey's post hoc comparison tests to compare the abundance of individual bird species across the six habitat types. Species with fewer than 5 observations across all years were excluded. Since any given management regime is expected to benefit some species over others, Partners in Flight "Avian Conservation Scores" were used to provide a sense of the relative conservation importance of the bird communities observed across the various habitat settings. This was accomplished by weighting the abundance of each species by its conservation score, and then aggregating these values for each of the six habitat types. Variation in bird community composition among habitats was visualized using a non-metric multidimensional scaling (NMDS) ordination and tested for statistically significant differences using a permutational multivariate analysis of variance (PERMANOVA).

Findings

This study revealed that small, diversified farming operations in New England are providing breeding habitats for priority shrubland birds. As such, these working lands are serving to complement more deliberate efforts by wildlife managers to manage habitats for at-risk shrubland birds. Findings can also inform how small-scale producers can optimize the value of their operations for priority shrubland birds while supporting pollination, pest control, and other ecosystem services.

Shrubland species represent a significant component of the bird community on farms. Over the two years of the study, 2,493 individual birds and 66 species were recorded across the 22 farms (Table 2). Twenty one of those species were shrubland birds (Schlossberg and King, 2007), accounting for 52% of the total observations. Shrubland birds also accounted for 72% of all breeding behaviors (i.e., singing male, courtship display, chick provisioning, etc.) observed during point counts, whereas non-shrubland species were more frequently observed exhibiting foraging behaviors.

Farms support both major shrubland bird associations. Previous studies of shrubland bird habitat preferences in the northeast identified a distinct split between species that prefer tall, shrub-dominated vegetation, and those that prefer areas of shorter vegetation with more abundant grass or forb cover (Schlossberg et al., 2010). Shrubland birds using small, diversified farms diverged into similar groupings based on their habitat preferences. The first group included species such as indigo bunting, gray catbird, common yellowthroat, and song sparrow, which were more abundant in areas with taller, higher density vegetation and more shrub and tree cover.

The second group of species—willow flycatcher, yellow warbler, American goldfinch, and song sparrow—were associated with shorter and more open-structured habitats such as non-production herbaceous vegetation, fallow fields, and cover crops. These species occupy similar habitat niches in other shrubland habitats found in New England, such as wildlife openings, regenerating clearcuts, and utility rights-of-way.

Some shrubland birds prefer smaller fields. Although some shrubland bird species prefer large habitat patches, others are less sensitive to patch area and are able to use smaller openings (Roberts and King, 2017). In this analysis, gray catbird and common yellowthroat both exhibited a negative relationship with field size. This study's finding is consistent with a number of previous studies reporting that smaller field sizes promote greater biodiversity and abundance of birds in agricultural areas, a relationship that is likely driven by the increased proportion of natural or semi-natural habitats in landscapes where fields in production are smaller or more heterogeneous.

Shrubland birds differ in landscape composition preferences. Landscape-scale relationships were species-specific, but nearly all of the shrubland species (with the exception of song sparrow) exhibited strong relationships with at least one landscape variable. American goldfinch and gray catbird were positively associated with percent cover of forest and wetland, negatively associated with agriculture, and diverged on development, with goldfinches positively related and catbirds negatively related. Indigo bunting abundance was higher in fields with more agricultural landcover in the surrounding area. Yellow warblers were positively related to wetland cover, while common yellowthroats and willow flycatchers were more abundant in less forested landscapes, likely reflecting these species' preference for dense, yet patchy, thickets and wetlands, rather

Table 2. Bird species (in descending order of abundance) detected during point count surveys on 22 small diversified farms in western Massachusetts, 2017 and 2018. Shrubland species indicated with "". Species considered pests of some crops indicated with "p".*

Species	2017	2018	Total
Song sparrow (Melospiza melodia)*	256	303	559
American robin (Turdus migratorius) p	142	136	278
Gray catbird (Dumatella carolinensis)*	97	91	188
Chipping sparrow (Spizella passerina)	83	62	145
Red-winged blackbird (Agelaius phoeniceus) p	77	64	141
American goldfinch (Spinus tristis)*	59	56	115
House sparrow (Passer domesticus) p	54	34	88
Mourning dove (Zenaida macroura)	38	29	67
Common yellowthroat (Geothlypis trichas)*	31	32	63
Cedar waxwing (Bombycilla cedrorum)* p	15	38	53
House finch (Haemorhous mexicanus)	36	16	52
European starling (Sturnus vulgaris) p	30	20	50
Northern cardinal (Cardinalis cardinalis)*	33	14	47
Brown-headed cowbird (Molothrus ater) p	20	22	42
Indigo bunting (Passerina cyanea)*	22	17	39
Eastern phoebe (Sayornis phoebe)	24	14	38
Killdeer (Charadrius vociferus)	23	15	38
Baltimore oriole (Icterus galbula)	21	14	35
Yellow warbler (Setophaga petechia)*	24	9	33
Blue jay (Cyanocitta cristata)	19	11	30
Eastern kingbird (Tyrannus tyrannus)	17	13	30
Willow flycatcher (Empidonax traillii)*	17	10	27
Black-capped chickadee (Poecile atricapillus)	17	9	26
Eastern bluebird (Sialia sialis)	15	10	25
Downy woodpecker (Dryobates pubescens)	11	9	20
Northern mockingbird (Mimus polyglottos)*	13	6	19
American redstart (Setophaga ruticilla)	15	1	16
Red-eyed vireo (Vireo olivaceus)	12	4	16
Common grackle (Quiscalus quiscula) p	4	10	14
Tufted titmouse (Baeolophus bicolor)	3	11	14
House wren (Troglodytes aedon)*	7	6	13
Rose-breasted grosbeak (Pheucticus ludovicianus)	7	6	13
American crow (Corvus brachyrhynchos) p	9	3	12

Species (continued)	2017	2018	Total
Field sparrow (Spizella pusilla)*	8	4	12
Black-billed cuckoo (Coccyzus erythropthalmus)*	5	5	10
Bobolink (Dolichonyx oryzivorus)	8	2	10
Chestnut-sided warbler (Setophaga pensylvanica)*	5	5	10
Red-bellied woodpecker (Melenerpes carolinus)	5	5	10
Least flycatcher (Empidonax minimus)	6	3	9
Alder flycatcher (Empidonax alnorum)*	2	5	7
Ruby-throated hummingbird (Archilochus colubris)*	6	1	7
Warbling vireo (Vireo gilvus)	4	3	7
Black-and-white warbler (Mniotilta varia)*	5	1	6
Spotted sandpiper (Actitis macularius)	5	1	6
Blue-winged warbler (Vermivora cyanoptera)*	4	0	4
Northern flicker (Colaptes auratus)	3	1	4
Veery (Catharus fuscescens)	2	2	4
White-breasted nuthatch (Sitta carolinensis)	3	1	4
Yellow-billed cuckoo (Coccyzus americanus)*	3	1	4
Wild turkey (Meleagris gallopavo)	0	3	3
Wood thrush (Hylocichla mustelina)	2	1	3
Yellow-bellied sapsucker (Sphyrapicus varius)	1	2	3
Blue-headed vireo (Vireo solitarius)	1	1	2
Brown thrasher (Toxostoma rufum)*	2	0	2
Eastern wood-pewee (Contopus virens)	1	1	2
Great crested flycatcher (Myiarchus crinitus)	1	1	2
Louisiana waterthrush (Parkesia motacilla)	2	0	2
Orchard oriole (Icterus spurius)	1	1	2
Ovenbird (Seiurus aurocapilla)	2	0	2
Pine warbler (Setophaga pinus)	1	1	2
Red-tailed hawk (Buteo jamaicensis)	2	0	2
Scarlett tanager (Piranga olivacea)	1	1	2
Eastern towhee (Pipilo erythrophthalmus)*	0	1	1
Hairy woodpecker (Dryobates villosus)	0	1	1
Purple finch (Haemorhous purpureus)	1	0	1
Yellow-throated vireo (Vireo flavifrons)	1	0	1

than tree cover (Schlossberg and King, 2007).

Crop pests are more abundant in larger fields with more bare ground and rowcrop cover. Generally, birds considered crop pests responded negatively to habitat conditions that were shown to benefit priority shrubland birds. American robin, European starling, cedar waxwing, red-winged blackbird and house sparrow were more abundant in areas associated with production agriculture and avoided taller and denser vegetation. Furthermore, cedar waxwings and house sparrows were associated with larger fields, while priority shrubland birds appear to prefer smaller openings. At the landscape-scale, American robin, cedar waxwing, and house sparrow were all positively associated with increased development in the surrounding landscape. While it typically is not possible for farmers to address landscape-scale factors outside their property boundaries, those seeking to discourage crop damaging birds and support shrubland species can consider increasing the prevalence of structurally complex, non-production habitats and decreasing farm field sizes where compatible with production goals.

Bird community composition on small, diversified farms resembles wildlife openings. Combined analysis of point count data from small, diversified farms and five other shrubland habitats (wildlife openings, clearcuts, small forest openings, powerline rights-of-way, and beaver meadows) allowed for a broad-scale evaluation of the contribution farms make to shrubland bird conservation in New England. Of the shrubland species present on farms, several (song sparrow, northern mockingbird, northern cardinal, house wren, willow flycatcher, and yellow-billed cuckoo) were found either exclusively or in higher abundance on farms than in any of the other habitats. Bird community composition on farms was most similar to state-managed wildlife openings and most different from small forest openings and powerline rights-of-way. This may reflect the origins of wildlife openings in New England, many of which are “old-field” habitats derived from abandoned agriculture, which thus contain more forb and fern cover and fewer woody stems than “young-forest” habitat created by silvicultural activities (King et al., 2009b). The finding that shrubland bird communities on small farms are similar to habitats deliberately managed to benefit at-risk species suggests these working lands are important contributors to shrubland bird conservation in the region.

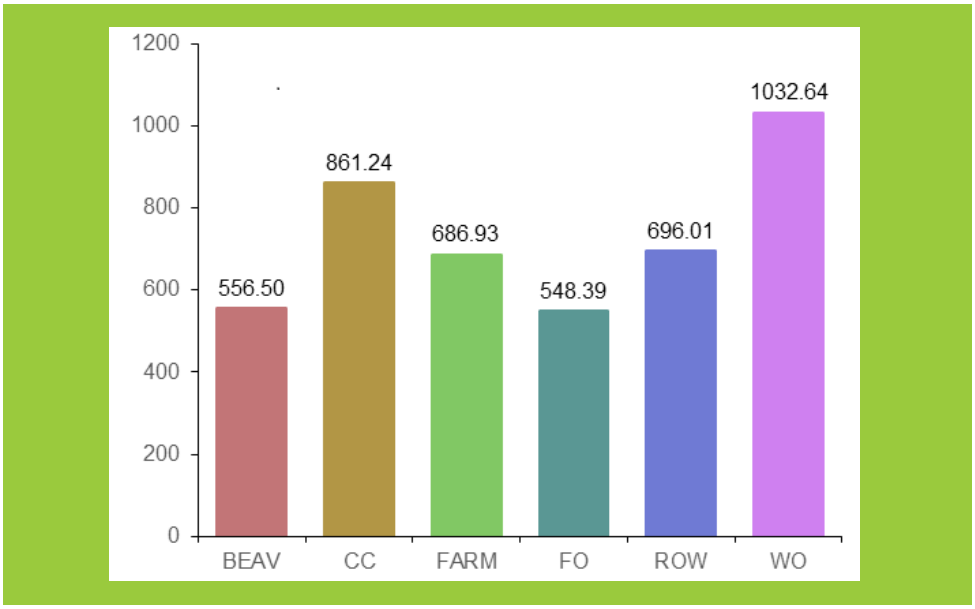

Figure 1. Avian Conservation Significance (ACS) scores for each of the six habitat types: beaver meadows (BEAV), clearcuts (CC), rights-of-way (ROW), and wildlife openings (WO) collected between 2002-2006, small forest openings (FO) collected in 2014, and on small, diversified farms (FARM) collected between 2017-2018 in western Massachusetts. ACS scores are based on point count data weighted by their Partners in Flight Conservation Scores.

Conservation value of small, diversified farms is comparable to other shrubland habitats. In terms of Avian Conservation Significance (ACS), farms scored higher than beaver meadows and small forest openings, and lower than powerline rights-of-way, clearcuts, and wildlife openings (Fig. 1). The ACS score for farms was driven by species with high regional Partners-in-Flight scores such as Baltimore oriole, rose-breasted grosbeak, and blue-winged warbler, as well as species present in high abundance such as song sparrow. Species such as eastern towhee, prairie warbler, and chestnut-sided warbler contributed the highest percentage to wildlife openings, powerline rights-of-way, small forest openings, and clearcuts, whereas conservation values in beaver meadows were driven by swamp sparrow, common yellowthroat, and Baltimore oriole.

Conclusions

Small, diversified farms in New England support high numbers of shrubland birds, including species that have experienced declines over recent decades. Furthermore, the conservation value of these farms in terms of the birds they support rivals that of some shrubland types widely regarded as high-quality habitat. The finding that small, diversified agricultural operations provide similar bird conservation value as other habitats recognized as important contributors to shrubland bird conservation in New England reveals the important conservation contribution being made by these productive working lands.

Due to variation among species in habitat associations, it is difficult to make a single recommendation for farm-level practices to promote bird conservation that accommodates all

priority shrubland species. However, farmers can promote bird conservation on their farms, while also reducing numbers of pest species, by providing tall, dense vegetation in non-production areas; increasing cover of hedgerows, shrub, and woodland habitats; and minimizing field sizes where compatible with production goals (Fig. 2). These practices support priority shrubland bird species such as gray catbird, common yellowthroat, and indigo bunting, while also discouraging crop pests such as cedar waxwing, European starling, and house sparrow. For other shrubland species, however, such as American goldfinch, yellow warbler, willow flycatcher, and song sparrow, availability of herbaceous cover in the form of cover crops, crop fields, and fallow areas is key. Structurally homogenous farms lacking a diversity of habitats are less desirable from a bird conservation standpoint.

Assessment of the bird conservation value of small diversified farms in New England provides support to the idea that habitat conservation and food production may coexist to benefit both agriculture and wildlife.

Figure 2. An example of a high conservation value farm incorporating a range of habitat features found positively associated with the abundance of birds of conservation interest. These features include a heterogeneous mix of herbaceous rowcrops and cover crops, surrounded by shrub and woodland cover. This farm had a high "Avian Conservation Score" of 31.2, which was ten times the Avian Conservation Score of structurally homogenous farms lacking these habitat features. Photo credit: Isabel Brofsky.

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Photo credit: Isabel Brofsky

Song sparrows were the most abundant shrubland species found on small, diversified farms. They were associated with herbaceous non-production habitats such as cover crops. Their populations in New England have declined in recent decades.

Photo credit: Dave King

Researcher Isabel Brofsky conducted point count surveys on multiple farms to quantify bird abundance and diversity.

Conservation Effects Assessment Project: Translating Science into Practice

The Conservation Effects Assessment Project (CEAP) is a multiagency effort to build the science base for conservation. Project findings will help to guide USDA conservation policy and program development and help farmers and ranchers make informed conservation choices.

One of CEAP's objectives is to quantify the environmental benefits of conservation practices for reporting at the national and regional levels. Because wildlife is affected by conservation actions taken on a variety of landscapes, the CEAP-Wildlife National Component complements the CEAP National Assessments for cropland, wetlands, and grazing lands. The Wildlife National Assessment works through numerous partnerships to support relevant assessments and focuses on regional scientific priorities.

This project was conducted through a collaborative effort by private landowners, researchers with University of Massachusetts, and the Conservation Effects Assessment Project. Primary authors of this document were Isabel Brofsky and David King, University of Massachusetts.

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